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Validation of Real-Time GOES Products Using GLAS and CALIPSO Data

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Introduction

Cloud properties are currently being derived in near-real time at NASA Langley Research Center from operational geostationary satellite data for applications such as aircraft icing detection and MWP model assimilation. These include cloud amount, top height, thickness, base height, phase, effective particle size, and condensed/frozen water path among others. Data from the Geostationary Operational Environmental Satellites, GOES-11 & 12, are analyzed each half hour over a large portion of North America to provide input for the applications. When these parameters are used it is important to know their uncertainties. Cloud height is a first order parameter for weather forecasting and aircraft icing. Before the advent of lidars in space, it has been very difficult to assess the uncertainties in the cloud heights in any rigorous manner. To have a rapid and continuous evaluation of the cloud-top heights derived from the Langley products, an automated system has been developed to match the archived and near-real-time products with the cloud information determined from the lidars on the Ice Cloud and Land Elevation Satellite (ICESat) and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite. The new algorithms take the predicted paths of each satellite lidar and extract those GOES pixels that match the path most closely in time and space. The results are compared both visually by overlaying the GOES analyses and quantitatively by differencing the GOES and lidar cloud height products. By using both ICESat and CALIPSO data, it is possible to assess the GOES cloud height uncertainties over many different local times because of differences in the orbits of the two lidar satellites. This paper presents the methodology and results from the initial comparisons.

Data and Methodology

A satellite orbital program is used to predict ICESAT and CALIPSO tracks over the Continental US (CONUS, fig 1. red box). The tool matches pixels from the GOES derived cloud products along the CALIPSO and ICESAT tracks. These products are inserted into a database along with the Lidar-Radar and GLAS products. An interactive web-based validation tools provides graphical interface to match and plot GOES products with CALIPSO or GLAS.

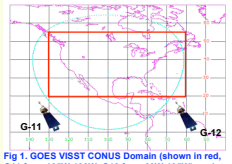


Fig 1. GOES VISST CONUS Domain (shown in red, G11 from 105W-130W, G12 from 60W-105W), and CloudSat/CALIPSO region (shown in cyan)

Real-time GOES-11/-12 VISST Products

- Uses the Visible Infrared Solar-Infrared Split-window Technique (VISST: Minnis et al. 1995)
- VIS (0.65um), solar-infrared (3.9um), IR (10.8um), and split-window (12.0um or 13um) data were analyzed at 4km resolution over Continental US (CONUS, fig 1. Red box) every 30 min.

0.65 µm Reflectance	Broadband Albedo	Optical Depth	Cloud Bottom Pressure
1.6 µm Reflectance	Broadband Infrared	Effective Radius/Diameter	Cloud Top Height
3.7 µm Temp	Cloud Mask	Liquid/Ice Water Path	Cloud Effective Height
6.7 µm Temp	Cloud Phase	Cloud Effective Temp	Cloud Bottom Height
10.8 µm Temp	Pixel Latitude	Cloud Top Pressure	Skin Temperature
12 or 13.3 µm Temp	Pixel Longitude	Cloud Effective Pressure	Infrared Emittance

CALIPSO and CloudSat Products

- 2B-GEOPROF-Lidar Products (R04) were obtain from the CloudSat Data Processing Center (DPC) at CSU. This dataset combines CloudSat Radar and CALIPSO Lidar data to best estimate cloud layers (Mace et al.).
- Validation using Radar-Lidar cloud top height and based

ICESAT GLAS Products

- GLAS09 R128 medium resolution products
- Validation using Cloud Heights from 1064nm products

Quicklook Browse Image Websites

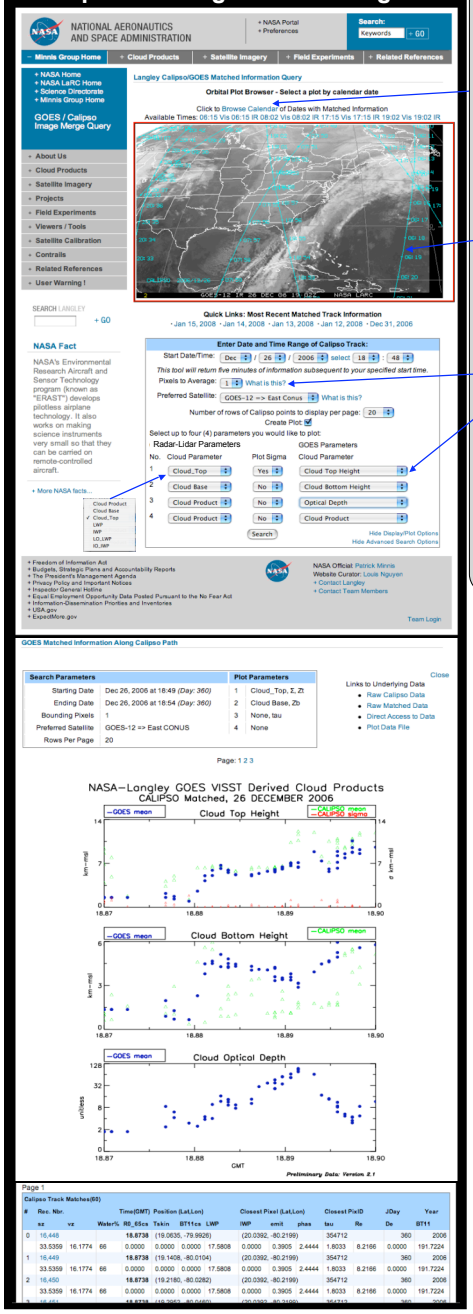
- Langley Cloud and Radiation Group: http://www-angler.larc.nasa.gov/
- CALIPSO LIDAR Browser: http://www-calipso.larc.nasa.gov/products/
- CloudSat Radar Browser: http://www.cloudsat.cira.colostate.edu/dpcstatusQL.php

Products Inserted into MySQL Database

- GOES cloud products are extracted along ICESAT and CALIPSO nadir tracks
- CALIPSO-CloudSat and GLAS products
- Database provides flexibility for searching and matching GOES products from a web-based validation tool

GOES Product Validation Tool

http://www-angler.larc.nasa.gov

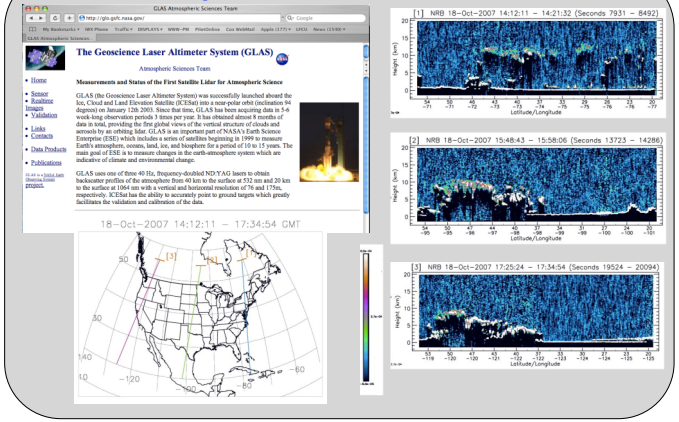


Date Selection Tool for GOES imagery

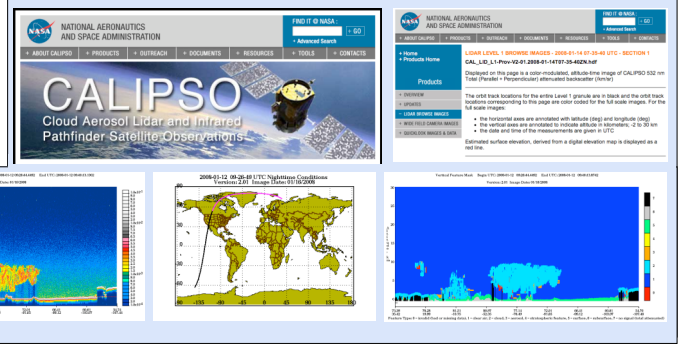
CALIPSO or GLAS Satellite Tracks

Allow user to select the num of pixels to average around the center matching GOES pixel

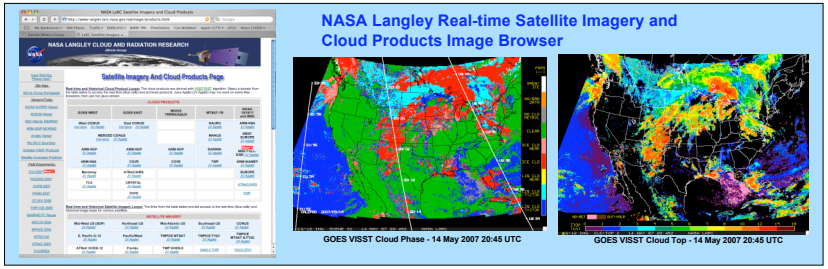
GLAS Real-time Image Browser



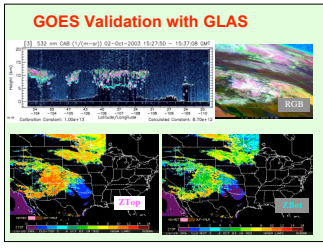
CALIPSO Real-time Image Browser



NASA Langley Real-time Satellite Imagery and Cloud Products Image Browser



GOES Validation with GLAS



GOES Validation with CALIPSO-CloudSat